and for power may not be reduced also, so that while the flame-lighting power may be reduced without much detriment, the consequent fall of heating-power may be a serious loss to the public. In the London Gas Act, 1905, such risk has been met by the obligation to test the calorific value of the gas for information only, but no penalties are incurred, even though the gas should prove to be of much less heating value than it has been.

The gas referees have therefore had the question of a suitable calorimeter before them, and in the "Notification" issued on January 1 (see p. 273) the calorimeter designed by Mr. Boys, who is one of them, is prescribed for use in official testings.

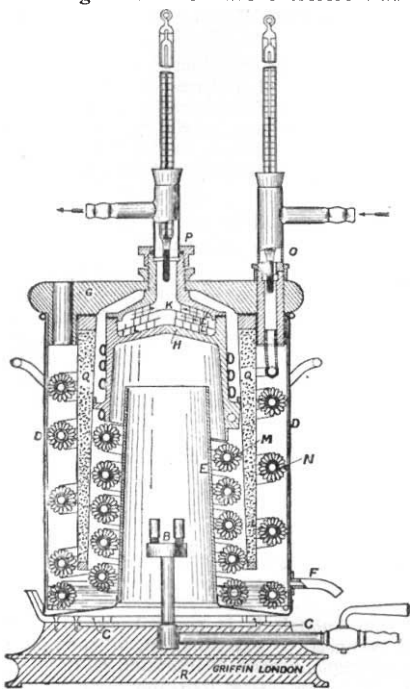

FIG. 1.

The calorimeter in question is of the Hartley type, *i.e.* a stream of water constantly passes through the instrument, and in so doing it is raised in temperature by the heat produced by the combustion of a stream of gas. The observations available enable the observer to ascertain the calorific value of the gas.

The best known instrument of this class is the Junker calorimeter, and it is in relation to this that the new features introduced by Mr. Boys are best described. From the accompanying figure it will be seen that the gas is burned at two small union jets instead of in the usual long Bunsen flame. The hot gases rising into the bell H descend outside the chimney E through the wires of the inner coil M. This and the outer coil N are made of the well known motor-car radiator tube invented by Mr. Clarkson. The circulating water enters the outer coil at the union O, and leaving the inner coil enters the space above the bell H, where it circulates between two dished plates and then leaves at the union P. The two lower turns of the Clarkson tube are immersed in a condensed water bath with an overflow F, which may be turned in any direction. This water bath serves to keep the chimney cool enough not to burn, but not cool enough to cause condensation to occur on the inner surface. One result of this construction is the slow passage of the products of combustion through the instrument and the small resistance they encounter. Hence the instrument need not be more than a foot high. The circulation of the water through the instrument strictly in series in every part prevents the formation of pockets or streaks of warmer water and consequent spasmodic changes of the outlet thermometer reading, and such small changes as might remain are almost entirely destroyed in the temperature equalising chamber above the bell H. The result is that, with a rise of temperature of 23° C., the variations do not exceed two or three hundredths of a degree, and even this appears to be largely due to friction in the meter insufficiently corrected by the governor.

Five minutes after lighting the gas the outlet thermometer is within 6 per cent. of its ultimate rise; in ten minutes it is within 2·2 per cent., and in fifteen minutes it is less than ½ per cent. In this and other respects the gas examiner who will have to use the instrument will find that not only accuracy, but his convenience has been studied.

One feature is quite peculiar. While hitherto gas calorimeters have been soldered up so as to be of the nature of mystery boxes, this can be seen in its essential features, while it can be completely taken to pieces in a few minutes for examination of every part.

After use the coil system is lifted out of the outer vessel by the lid and is then immersed in a dilute solution of bicarbonate of soda, so as to neutralise the weak sulphuric acid condensed upon the metal and prevent it and its dissolved oxygen from prematurely destroying the metal-work of the coils. The instrument is made by Messrs. Griffin and Sons.

THE ELECTRIC PRODUCTION OF NITRATES FROM THE ATMOSPHERE.[1]

AS the demand of the white races for wheat as a foodstuff increases, the acreage devoted to wheat growing increases, but at a less rapid rate; and being limited by climatic conditions will in a few years, perhaps less than thirty, be entirely taken up. Then, as Sir William Crookes pointed out in his presidential address in 1898, there will be a wheat famine, unless the world's yield per acre (at present about 12·7 bushels per acre on the average) can be raised by use of fertilisers. Of such fertilisers the chief is nitrate of soda, exported from the nitre beds in Chili. The demand for this has risen from 1,000,000 tons in 1892 to 1,543,120 tons in 1905, and the supply will at the present rate be exhausted in less than fifty years. Then the only chance of averting starvation lies, as Crookes pointed out, through the laboratory.

In 1781, Cavendish had observed that nitrogen, which exists in illimitable quantities in the air, can be caused to enter into combination with oxygen, and later he showed that nitrous fumes could be produced by passing electric sparks through air. Although this laboratory experiment had undoubtedly pointed the way, though the chemistry of the arc flame had been investigated in 1880 by Dewar, and though Crookes and Lord Rayleigh had both employed electric discharges to cause nitrogen and oxygen to enter into combination, no commercial process had been found practical for the synthesis of nitrates from the air until recently.

After referring, in passing, to the tentative processes of Bradley and Lovejoy, of Kowalski, of Naville, and to the cyanamide and cyanide processes, attention was directed to the process of Birkeland and Eyde, of Christiania, for the fixation of atmospheric nitrogen, and their synthetic production of nitrates, by use of a special electric furnace. In this furnace an alternating electric arc was produced at between 3000 and 4000 volts, but under special conditions which resulted from the researches of Prof. Birkeland, the arc being formed between the poles of a large electromagnet, which forced it to take the form of a roaring disc of flame. Such a disc of flame was shown in the lecture theatre by a model apparatus sent from Christiania. In the furnaces, as used in Norway, the disc of flame was 4 feet or 5 feet in diameter, and was enclosed in a metal envelope lined with firebrick. Through this furnace air was blown, and emerged charged with nitric oxide fumes. These fumes were collected, allowed time further to oxidise, then absorbed in water-towers or in quicklime, nitric acid and nitrate of lime being the products. The research station near Arendal was described, also the factory at Notodden, in the Hitterdal, where electric power to the extent of 1500 kilowatts was already taken from the Tinnfoss waterfall for the production of nitrate of lime. This product in several forms, including a basic nitrate, was known as Norwegian saltpetre. Experiment had shown that it was equally good as a fertiliser with Chili saltpetre, and the lime in it was of special advantage for certain soils. The yield of product in these furnaces was most satisfactory, and the factory at Notodden—which had been in commercial operation since the spring of 1905—was about to be enlarged; the neighbouring waterfall of

[1] Abstract of a discourse delivered at the Royal Institution on Friday, February 2, by Prof. Silvanus P. Thompson, F.R.S.

Svaelgfos being now in course of utilisation would furnish 23,000 horse-power. The Norwegian company had further projects in hand for the utilisation of three other waterfalls, including the Rjukanfos, the most considerable fall in Telemarken, which would yield more than 200,000 horse-power. According to the statement of Prof. Otto Witt, the yield of the Birkeland-Eyde furnaces was more than 500 kilograms of nitric acid per year for every kilowatt of power. The conditions in Norway were exceptionally good for the furnishing of power at exceedingly low rates. Hence the new product could compete with Chili saltpetre on the market, and would become every year more valuable as the demand for nitrates increased, and the natural supplies became exhausted.

POLAR EXPLORATION.

AFTER discussion at a meeting of explorers and geographers interested in the study of the polar regions, a statement was submitted to the congress held at Mons in September, 1905, setting forth the expediency of founding an International Association for the Study of the Polar Regions, with the objects of "(1) obtaining an international agreement upon different questions associated with polar geography; (2) making a general effort to reach the terrestrial poles; (3) organising expeditions having for their object an extension of our knowledge of the polar regions in every respect; and (4) forming a programme of scientific work to be carried out in the different countries during the existence of the International Polar Expeditions." The congress unanimously passed a resolution expressing the wish "(1) to see the formation of this Association in 1906 by a previous meeting of a general Conference of the larger scientific and maritime nations, who have taken part in the principal polar expeditions up to the present time; and (2) to see that the Belgian Government takes the initiative in approaching the Governments of other countries."

We have received a copy of a letter which has been addressed by M. Lecointe, to whom the congress entrusted the work of making the necessary preliminary arrangements, to the presidents of academies and of learned societies all over the world. It is proposed to hold the first conference at the beginning of May, for the consideration of general questions, and to discuss in detail "(1) the basis of a series of polar expeditions; (2) the programme of term of observations to be carried out in all the observatories; and (3) the text of the working arrangements of the international Association" at a second conference, composed of State delegates and delegates from academies and learned societies, in September. The conclusions arrived at by the second conference will be transmitted for examination to the Belgian Government, which eventually will ask the support of other countries for the new association.

In connection with the proposed International Association for the Study of the Polar Regions, M. Lecointe invites polar explorers to send him papers or notices dealing with questions which will be considered at the general conference in May next. A paper of the kind has been issued in which M. Henryk Arctowski makes a number of suggestions for work in the future. M. Arctowski expresses the opinion that in future Arctic research much use may be made of ice-breakers of the type of Makaroff's *Yermak*. With regard to Antarctic exploration, the settlement of the continental question is admittedly of primary importance, but M. Arctowski strongly urges the advisability of exploring thoroughly the circumpolar areas as a preliminary, especially by hydrographical expeditions.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The recommendation of the Forestry Syndicate with regard to the general management of the examinations, the schedules of the proposed forestry examination, &c., passed the Senate last Thursday. The most important of these recommendations is that the general conduct of the examinations and the prescription of courses of training are to be entrusted to a committee of the Board of Agricultural Studies. Such a committee will include the professors of agriculture, botany, chemistry, and geology, and the reader in agricultural chemistry, together with three other members of the Board of Agricultural Studies. The committee will have the power to co-opt annually, if it thinks fit, four other persons.

The professor of experimental physics gives notice that a course of three lectures on "The Life-history of Surface Air Currents" will be given by Dr. W. N. Shaw, F.R.S., director of the Meteorological Office, in the Cavendish Laboratory on Wednesdays, February 14 and February 21, and Thursday, March 1.

LONDON.—Prof. E. A. Minchin commenced at University College on Monday a course of lectures on "Parasitic Protozoa." Prof. Minchin recently returned from Uganda, where he was engaged as one of the special commissioners of the Tropical Diseases Committee of the Royal Society in research on the life-history of the trypanosome of sleeping sickness.

PROF. DRUDE has been elected rector of the Dresden Technical High School for the ensuing year.

DURING January, Dr. Bolam, lecturer on chemistry at Queen Margaret College, Glasgow University, delivered in Leith Nautical College a short course of lectures on "The Chemistry of Dangerous Cargoes" to large nautical audiences. Mr. James Currie (of Messrs. James Currie and Co.) presided, and pointed out the importance of the course in view of the very complex cargoes merchant ships were now carrying.

MR. H. F. TRIPPEL directs attention to an important point in connection with army entrance examinations in a letter to the *Pall Mall Gazette* of February 3. Mathematics is a compulsory subject for every candidate competing for admission to the Royal Military Academy, Woolwich; yet Mr. Trippel says that in the recent examination one of the competitors who scored zero in mathematics was placed among the successful candidates. It appears, therefore, that though it is compulsory to take mathematics in the competitive examination, a candidate may do so without having any serious intention of gaining a single mark in the subject. Now that the attention of the authorities has been directed to the defect in the regulations which permits this course to be followed, it is to be hoped that a minimum standard of marks to be gained in mathematics by all candidates will be prescribed, or some other remedy found.

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, January 10.—Dr. J. E. Marr, F.R.S., president, in the chair.—The clay-with-flints: its origin and distribution: A. J. **Jukes-Browne.** Until recently the clay-with-flints has been regarded as being, in the main, a residue from the slow solution of the Chalk. Of late years, the opinion has been growing that it consists very largely of material derived from the Eocene. The present paper is devoted to an examination of the facts, with the view of ascertaining whether the clay-with-flints could possibly be derived from the Chalk, or whether the theory of its derivation from the Eocene is confirmed by more detailed inquiry. From several lines of investigation the author concludes (1) that the clay-with-flints cannot have been formed from mere solution of the Upper Chalk; (2) that all its components, except the unbroken and angular flints, could have been furnished by the Reading beds; (3) that the positions occupied by it are such that no great thickness of Chalk can have been destroyed to form it, the tracts being seldom more than 30 feet or 40 feet below the local plane of the Eocene base, or the presumed level of that plane.—Footprints from the Permian of Mansfield (Nottinghamshire): G. **Hickling.** These fossils were discovered in 1897 by Mr. Francis Holmes in the Rock Valley Quarry, Mansfield, in a local, lenticular mass of sandstone intercalated in the Magnesian Limestone. The prints present some resemblance to those named *Ichnium acrodactylum*, from the Upper Permian of Thuringia.